

8. Summary/Conclusion

In general, all the subwatersheds within the Northeast Basin represent areas of diverse geography ranging in elevation from 18 to 11,750-ft as well as a variety of land uses (undisturbed, timber, grazing, urban, irrigated agricultural), and hydrologic management (from the unregulated Cosumnes River to the highly modified and regulated Mokelumne and Calaveras).

Many constituents monitored displayed variations due to seasonal changes that were consistent with multiple interactions. For instance, temperature at all sites increased during the summer months regardless of flow and land use, as well as increased moving from upstream to downstream. Conversely, dissolved oxygen decreased at all sites during the warmer summer months. Other constituents, such as electrical conductivity, TOC and *E. coli* were seasonally influenced, particularly by storm events. The magnitude of the influence increased if the site experienced a dry period. The pH was variable throughout the year, regardless of season or location in the watershed.

The reservoirs appeared to stabilize some of the variability seen in the upper watershed sites, particularly in the ephemeral streams. For instance, in the Cosumnes Watershed, EC concentrations tended to increase consistently moving downstream. In contrast, reservoirs in the Mokelumne and Calaveras Watersheds had lower overall EC than their tributaries, while the sites below the reservoirs reflected the reservoir concentrations. The only exceptions to this pattern were total suspended solids and *E. coli* which both appear to increase moving downstream from the reservoirs—a pattern echoed moving downstream on the unregulated Cosumnes River.

Findings by individual watershed included:

Cosumnes River Watershed:

Total copper, potassium, and total suspended solids were highest in the Cosumnes Watershed.

Turbidity and TSS were highest overall at Jenkinson Lake at Pinecone campsites. Lake sites that were not at docks tended to have higher turbidity and TSS due to disturbance of the bottom of the lake by the motion of the water.

Total copper was highest at the Cosumnes River at Twin Cities Road in early spring. Throughout the rest of spring, total copper was below the detection limit. In general, copper was below the detection limit in the upper watershed areas, but was detectable in the lower watersheds.

The highest concentration for potassium was at the Cosumnes River at Highway 49. This occurred during the summer months, and likely was the result of a flush in potassium from upstream. In general, potassium throughout the watersheds ranged from below detection level to under 4 mg/L.

Mokelumne River Watershed:

Dissolved oxygen, pH, TOC and Nitrite + Nitrate had the highest measurements in the Mokelumne Watershed, with nitrite + nitrate and pH having the highest single readings at Lake Amador.

Dissolved oxygen in the Mokelumne Watershed tended to be higher than in the other watersheds, with the highest measurement being at Mokelumne River at Highway 49, just below the last of PG&E's powerhouses. DO at upper watershed sites were higher than in lower watershed sites.

The highest TOC measurement was taken at Sutter Creek, which also had the highest average and maximum concentrations for *E. coli*. Besides being stagnant through most of the summer months,

the Sutter Creek is also located in the middle of a rural foothill community and downstream of a number of septic systems.

Calaveras River Watershed:

The Calaveras Watershed contained several sites that were dry through parts of the year. Calaveritas Creek at Highway 49 was dry through the summer months, as well as North Fork Calaveras River at Gold Strike Road. Calaveras River at Highway 88 was full to capacity through the summer months, but dry during the winter months. These drying cycles in all watersheds affected electrical conductivity, *E. coli*, pH and dissolved oxygen.

The highest readings for electrical conductivity, hardness, total cadmium, and phosphorous occurred in the Calaveras Watershed. Within the watershed, Calaveritas Creek had the highest electrical conductivity, hardness, selenium, and phosphorous.

When evaluated against water quality objectives (Basin Plan, 2002), goals (Marshack, 2006), targets (CALFED, 2000), and guidelines (USEPA Contact Recreation), the water quality results indicate that, in general, beneficial uses of municipal supply, aquatic life, irrigation supply, and recreation do not appear impaired within the basin.

Some areas of concern have been identified as displayed in Figures 12-14 and are summarized below.

Drinking Water/Municipal Supply: Elevated TOC concentrations during storm runoff are indicative of potential to impact downstream Delta waterways. Seasonally elevated levels of *E. coli* may indicate the presence of pathogens and require treatment prior to use for municipal supply.

Aquatic life: Although no specific impairment was identified, there is some concern with elevated temperatures in the downstream most reaches of each of the major rivers during the spring and fall migration seasons. The elevated temperatures mimic the trend for the Cosumnes River, therefore a more thorough temperature survey and comparison is needed prior to determining potential impairment.

Recreation: Concentrations of *E. coli* (a subset of fecal coliform) have occurred above the water quality objective for fecal coliform (400 MPN/100-ml) at selected sites, but primarily during storm events and/or periods outside of typical recreational swim period (May to October). Comparison to USEPA contact recreation guidelines, which are based on *E. coli* concentrations, indicate that use may be limited to light, full body contact at selected sites in the Cosumnes and Calaveras Rivers during May storm events and low flow August time periods.

Table 12 Comparison of Results to Water Quality Objectives and Recommendations: Cosumnes Watershed

Site Code	Site Description	Type	Month																								
			Jan	Feb	Mar	Apr		May	Jun	Jul	Aug	Sep	Oct	Nov	Dec												
Drinking Water																											
ELD001	Jenkinson Lake @ Pinecone Campground	I							NS			NS	NS	NS					NS							NS	
ELD002	Jenkinson Lake @ Mormon Emigrant Trailhead	I							NS			NS	NS	NS					NS							NS	
ELD003	Cosumnes River @ Gold Beach Park	R									NS		NS	NS					NS							NS	
ELD004	Cosumnes River @ Highway 49	R							NS			NS	NS	NS					NS							NS	
SAC003	Cosumnes River @ Michigan Bar Road	R							NS			NS	NS	NS					NS							NS	
SAC001	Cosumnes River @ Twin Cities Road	R							NS			NS							D							5	
Aquatic Life																											
ELD001	Jenkinson Lake @ Pinecone Campground	I			2		3			NS			NS	1	NS	1	NS			1	1	NS					NS
ELD002	Jenkinson Lake @ Mormon Emigrant Trailhead	I	2	NS	2	NS	3	NS		NS			NS	1	NS	NS	NS			1		NS					NS
ELD003	Cosumnes River @ Gold Beach Park	R			2		3			NS			NS	NS	1	NS	NS			1	1	NS					NS
ELD004	Cosumnes River @ Highway 49	R			2		3			NS			NS	NS	1	NS	NS			1		NS					NS
SAC003	Cosumnes River @ Michigan Bar Road	R					3			NS			NS	1	NS	1	NS			1	1	NS					NS
SAC001	Cosumnes River @ Twin Cities Road	R					3							1	1	1	NS			D					4		
Recreation																											
ELD001	Jenkinson Lake @ Pinecone Campground	I	NS						NS			NS	NS	NS	NS					NS						NS	
ELD002	Jenkinson Lake @ Mormon Emigrant Trailhead	I	NS						NS			NS	NS	NS	NS					NS						NS	
ELD003	Cosumnes River @ Gold Beach Park	R	NS				NS			NS		9	NS	NS	NS	NS				NS						NS	
ELD004	Cosumnes River @ Highway 49	R	NS				NS			NS		9	NS	NS	NS	NS				NS						NS	
SAC003	Cosumnes River @ Michigan Bar Road	R	NS						NS			NS	NS	NS	NS	7				NS						NS	
SAC001	Cosumnes River @ Twin Cities Road	R	NS				9	7				9								D						8	
Irrigation																											
ELD001	Jenkinson Lake @ Pinecone Campground	I								NS			NS	NS	NS	NS					NS					NS	
ELD002	Jenkinson Lake @ Mormon Emigrant Trailhead	I								NS			NS	NS	NS	NS					NS					NS	
ELD003	Cosumnes River @ Gold Beach Park	R								NS			NS	NS	NS	NS					NS					NS	
ELD004	Cosumnes River @ Highway 49	R								NS			NS	NS	NS	NS					NS					NS	
SAC003	Cosumnes River @ Michigan Bar Road	R								NS			NS	NS	NS	NS					NS					NS	
SAC001	Cosumnes River @ Twin Cities Road	R																		D							
	- All samples collected were within Water Quality Objectives	S	- Stagnant										4	- Dissolved Oxygen <7.0 mg/L													
D	- Dry	1	- Temperature >20 -C										5	- Total Organic Carbon >3.0 mg/L													
NA	- Beneficial Use not applicable to the water	2	- pH <6.5										6	- Cadmium (Total) >0.07 ug/L													
NS	- No Sample Collected	3	- pH >8.5										7	- E. coli >235 (MPN/100mL)													
I	- Impoundment Site																										
R	- River Site																										

Table 13 Comparison of Results to Water Quality Objectives and Recommendations: Mokelumne Watershed

Site Code	Site Description	Type	Month																									
			Jan	Feb	Mar	Apr		May	Jun	Jul	Aug	Sep	Oct	Nov	Dec													
Drinking Water																												
AMA001	N. Fk. Mokelumne River @ Hw 26	R								NS			NS		NS				NS									
AMA002	Sutter Creek @ Highway 49	R								NS			NS		NS	NS			5			NS						
CAL004	Mokelumne River @ Highway 49	R								NS			NS		NS				NS				NS					
AMA003	Lake Amador @ Boat Launch	I								NS		5	NS	5	6	NS	5	NS					NS					
CAL005	Camanche Res. @ South Shore	I								NS		5	NS	6	NS		NS						NS					
SJC512	Mokelumne River @ Van Assen	R								NS	5		NS		NS		NS					NS	NS					
SAC002	Mokelumne River @ New Hope Rd.	R											5															
Aquatic Life																												
AMA001	N. Fk. Mokelumne River @ Hw 26	R								NS			NS		NS		NS						NS					
AMA002	Sutter Creek @ Highway 49	R								NS			NS	1	NS	1	NS		S	S	S	S		4	NS	NS		
CAL004	Mokelumne River @ Highway 49	R								NS			NS		NS		NS								NS			
AMA003	Lake Amador @ Boat Launch	I					3			3	NS	1	3	1	3	NS	1	3	NS	3	3	1	NS	1	1		NS	
CAL005	Camanche Res. @ South Shore	I				3					NS	1			NS	1	NS	1	NS		1	1	NS	1	1		NS	
SJC512	Mokelumne River @ Van Assen	R	2			3					NS				NS		NS			3	NS				2		NS	
SAC002	Mokelumne River @ New Hope Rd.	R				3		3	3	NS							1	1			1	1	1					
Recreation																												
AMA001	N. Fk. Mokelumne River @ Hw 26	R				NS					NS			NS		NS		NS				NS				NS		
AMA002	Sutter Creek @ Highway 49	R				NS					NS			NS		NS		NS		S	S	S	S	10	10		10	NS
CAL004	Mokelumne River @ Highway 49	R				NS					NS			NS		NS		NS				NS					NS	
AMA003	Lake Amador @ Boat Launch	I				NS					NS			NS		NS		NS				NS					NS	
CAL005	Camanche Res. @ South Shore	I				NS					NS			NS		NS		NS				NS					NS	
SJC512	Mokelumne River @ Van Assen	R				NS					NS			NS		NS		NS				NS					NS	
SAC002	Mokelumne River @ New Hope Rd.	R				NS								NS		NS		NS				NS					NS	
Irrigation																												
AMA001	N. Fk. Mokelumne River @ Hw 26	R	NA																									
AMA002	Sutter Creek @ Highway 49	R									NS			NS		NS		NS		S	S	S	S				NS	
CAL004	Mokelumne River @ Highway 49	R	NA																									
AMA003	Lake Amador @ Boat Launch	I	NA																									
CAL005	Camanche Res. @ South Shore	I									NS			NS		NS		NS				NS					NS	
SJC512	Mokelumne River @ Van Assen	R									NS			NS		NS		NS				NS					NS	
SAC002	Mokelumne River @ New Hope Rd.	R																				NS						
	- All samples collected were within Water Quality Objectives					S	- Stagnant					4	- Dissolved Oxygen <7.0 mg/L															
D	- Dry					1	- Temperature >20 -C					5	- Total Organic Carbon >3.0 mg/L															
NA	- Beneficial Use not applicable to the waterbody					2	- pH <6.5					6	- Cadmium (Total) >0.07 ug/L															
NS	- No Sample Collected					3	- pH >8.5					7	- E. coli >235 (MPN/100mL)															

- All samples collected were within Water Quality Objectives
 D - Dry
 NA - Beneficial Use not applicable to the waterbody
 NS - No Sample Collected
 I - Impoundment Site

R - River Site

S - Stagnant
 1 - Temperature >20 -C
 2 - pH <6.5
 3 - pH >8.5

4 - Dissolved Oxygen <7.0 mg/L
 5 - Total Organic Carbon >3.0 mg/L
 6 - Cadmium (Total) >0.07 ug/L
 7 - E. coli >235 (MPN/100mL)

Table 14 Comparison of Results to Water Quality Objectives and Recommendations: Calaveras Watershed

Site Code	Site Description	Type	Month																										
			Jan	Feb	Mar	Apr		May	Jun	Jul	Aug	Sep	Oct	Nov	Dec														
Drinking Water																													
CAL001	San Antonio Ck. @ Sheep Ranch	R							NS			NS		NS			NS				5			NS					
CAL002	Calaveritas Creek @ Hwy 49	R							NS			NS		NS		D								NS					
CAL003	N.Fk. Calaveras R. @ Gold Strike	R							NS			NS		NS		D								NS					
CAL006	New Hogan Res. @ Acorn East	I							NS		5	NS	5	6	NS	5	6	NS					NS				NS		
CAL007	New Hogan Res. @ Wrinkle Cove	I							NS		5	NS		NS	5	NS						NS				NS			
CAL008	Calaveras River @ Monte Vista	R							NS		5	NS		NS	5	NS						NS				NS			
SJC513	Calaveras River @ Hwy 88	R	D				NS				NS	5	NS	6	NS		NS					NS				D			
Aquatic Life																													
CAL001	San Antonio Ck. @ Sheep Ranch	R							NS			NS		NS		NS					NS					NS			
CAL002	Calaveritas Creek @ Hwy 49	R							NS			NS	1	NS	1	NS	D				4				NS				
CAL003	N.Fk. Calaveras R. @ Gold Strike	R							NS			NS	1	NS	1	NS	D									NS			
CAL006	New Hogan Res. @ Acorn East	I							NS			NS	1	NS	1	NS		3	1	1	NS	1	1	3			NS		
CAL007	New Hogan Res. @ Wrinkle Cove	I							NS	3		NS	1	3	NS	1	NS		1	1	NS	1	3	1	3		NS		
CAL008	Calaveras River @ Monte Vista	R							NS			NS		NS		NS					NS					NS			
SJC513	Calaveras River @ Hwy 88	R	D				NS			NS			NS	1	NS	1	NS		1	3	NS	NS				D			
Recreation																													
CAL001	San Antonio Ck. @ Sheep Ranch	R	NS						NS			NS		NS		NS					NS					NS	7		
CAL002	Calaveritas Creek @ Hwy 49	R	NS						NS			NS		NS		NS	D				7				NS				
CAL003	N.Fk. Calaveras R. @ Gold Strike	R	NS						NS			NS		NS		NS	D									NS			
CAL006	New Hogan Res. @ Acorn East	I	NS						NS			NS		NS		NS					NS					NS			
CAL007	New Hogan Res. @ Wrinkle Cove	I	NS						NS			NS		NS		NS					NS					NS			
CAL008	Calaveras River @ Monte Vista	R	NS						NS			NS		NS		NS					NS					NS			
SJC513	Calaveras River @ Hwy 88	R	D				NS	7			NS		7	NS		NS		NS	7			NS				D			
Irrigation Supply																													
CAL001	San Antonio Ck. @ Sheep Ranch	R	NA																										
CAL002	Calaveritas Creek @ Hwy 49	R	NA																										
CAL006	N.Fk. Calaveras R. @ Gold Strike	I	NA																										
CAL007	New Hogan Res. @ Acorn East	I	NA																										
CAL003	New Hogan Res. @ Wrinkle Cove	R	NA																										
CAL008	Calaveras River @ Monte Vista	R							NS			NS		NS		NS					NS				NS				
SJC513	Calaveras River @ Hwy 88	R	D				NS			NS			NS		NS		NS					NS			D	D	D	D	D
	- All samples collected were within Water Quality Objectives	S	- Stagnant												4	- Dissolved Oxygen <7.0 mg/L													
D	- Dry	1	- Temperature >20 -C												5	- Total Organic Carbon >3.0 mg/L													
NA	- Beneficial Use not applicable to the water	2	- pH <6.5												6	- Cadmium (Total) >0.07 ug/L													
NS	- No Sample Collected	3	- pH >8.5												7	- E. coli >235 (MPN/100mL)													
I	- Impoundment Site																												
R	- River Site																												

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9.0 FUTURE ACTIVITIES

Since this monitoring effort in the Northeast Basin (January through December 2002), monitoring plans have been finalized by the Water Quality Coalitions groups within the Basin as part of the Regional Board's Irrigated Lands Program. These monitoring activities are focused on areas below the major regulating reservoirs. Summary reports are available at: http://www.waterboards.ca.gov/centralvalley/programs/irrigated_lands/index.html#Monitoring The currently active group in this Basin is the South Sacramento – Amador Water Quality Alliance. Various coalition groups under the ILP have initiated studies to genetically identify sources of seasonally elevated levels of *E. coli*.

In the Cosumnes Watershed, stakeholder groups include the Cosumnes River Task Force, Foothill Conservancy, American River Conservancy and Cosumnes River Preserve. These groups continue work to promote education, restoration, and address concerns by both agencies and individuals. In 2004, the Cosumnes River Preserve was awarded a Proposition 50 Watershed Program grant to develop a comprehensive management plan for the Cosumnes River Preserve.

In the Mokelumne Watershed, stakeholder groups include the Alpine Watershed Group, Ebbetts Pass Forest Watch, Ebbetts Pass Rivers and Trail Alliance, Foothill Conservancy, and Upper Mokelumne River Watershed Council, which continue work to preserve and protect watershed health. In 2004, the Upper Mokelumne River Watershed Authority was awarded the first of two Proposition 50 Watershed Program grants to develop a watershed assessment and planning project for the Upper Mokelumne Watershed. The Upper Mokelumne Watershed Assessment and management Plan will be completed by March 2008. Not only does the Assessment include many years of water quality and watershed data, but the information has been used to calibrate a computer model, Watershed Analysis Risk Management Framework (WARMF) that has the ability to simulate future water quality impacts based on a variety of projected social and environmental conditions (urban growth, fire, etc.). The model will be maintained by East Bay Municipal Utility District and available to local planners (government and stakeholders alike).

In the Calaveras River Watershed, the active stakeholder groups are the Foothill Conservancy, which is actively involved in issues affecting the quality of life and natural environment in Amador and Calaveras counties, and the Calaveras River Stakeholders Group.

Based on information collected during this project, future monitoring efforts in this basin should consider:

- Coordinated monitoring with the Irrigated Lands Program and local stakeholder groups conducting grant funded monitoring.
- Expanded temperature surveys in the lower watershed areas during spawning and migration periods.
- A study in the Sutter Creek Watershed in order to better evaluate *E. coli* and TOC concentrations. Since many rural communities dispose of waste through septic systems rather than wastewater treatment facilities, further studies should evaluate potential impact of these systems on watersheds, including follow-up genetic tracer studies immediately after flushing storm events.
- Further evaluation of *E. coli* concentrations during the recreational season at local swimming holes.
- Addition of a site on Mormon Slough for comparison to Calaveras River @ Highway 88. As mentioned in the site description for Calaveras River @ Highway 88, the Calaveras River is largely diverted into Mormon Slough at Bellota Dam. The water sampled was representative of

an impounded stream rather than a flowing river. The additional site would allow us to study the affects of intensive agriculture on a body of water versus source water to the same area.

- Additional bacteria studies to determine appropriate sampling methodology, inherent site variability and acceptable analytical precision.

Monitoring will continue on a monthly basis at the long-term SWAMP sites that were included in this program. Trends will be monitored to determine if there are any areas that should be focused on in the coming monitoring years.

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